SUPPLEMENT TO "NATURE."

THE STORY OF OUR PLANET.

The Story of our Planet. By T. G. Bonney, D.Sc., LL.D., F.R.S., &c. Pp. 592. (London: Cassell and Co., 1893.)

IN the workshop of science there are many labourers, both skilled and unskilled, and the particulars of their toil, which are not always interesting even to fellow-workers, can seldom be appreciated or even understood by the majority of well-educated persons. The increasing detail of geological work and the number of technical terms introduced, necessary as they are to progress, are calculated to repel not only the unemployed, who might like to gain a general knowledge of the subject, but also the numerous workers in other branches of science, who cannot keep themselves informed on the meaning of the many new terms. Nor can text-books, intended for serious study, be made interesting to the general reader, for the student wants his mental food in a concentrated form, with particulars sufficient for the class-room and examination; while the general reader can only be tempted with the net results of science in a diluted and yet attractive form. Such a reader, too, may approve of the Frenchman's dictum (quoted by William Spottiswoode in his address to the British Association, 1878), that no scientific theory "can be considered complete until it is so clear that it can be explained to the first man you meet in the street." It may, however, take a long time or a big book to do this, though we may agree that conclusions are not of much service unless they are intelligible.

In old days, Lyell's "Principles of Geology," as remarked by Prof. Bonney, "would have been understood with little difficulty by any man of good general education." Twenty-one years have passed since the last edition of that work was published, and we quite agree with the present author that there is "room for a book which covers somewhat the same ground."

The "Story of our Planet" is intended "for men and women of good general education who might desire to know something of the methods of reasoning which are adopted in geology, and of the general conclusions to which these have led." Thinking it would be helpful to get an independent opinion on the book, the writer, after cutting its leaves, placed the volume in the hands of his wife (who is by no means geological), and asked her to read a few pages. She did so, and without a pause read steadily to the end of the first chapter, exclaiming "It is most interesting." This independent testimony was satisfactory, but it requires a little qualification when applied to the volume as a whole. The author commences his work with an account of three specimens, taken almost haphazard, from a collection of fossils. Curiously enough, and perhaps unconsciously, he has returned to an old love, for one of the fossils is *Melania inquinata*, a shell which he obtained thirty-four years ago from the Eocene beds of Charlton, near Woolwich. It is mentioned among others in a short account, perhaps his earliest geological communication, which was printed in the *Geologist* for 1859 (p. 296). Since then the author has wandered in many fields, and has found much happiness of a kind he is wishful to impart to others. Around Cambridge he has examined and written about the Cretaceous and Jurassic strata. He has gone deeper, and discussed the origin of Triassic rocks. Finally, he has descended to the lower regions, and plied his hammer among "The Foundation Stones of the Earth's Crust," as he would call them. Thus from the top to the bottom of the series he has studied the records of the rocks, but ever and anon the vestiges of ancient volcanoes have attracted great attention, and fired an enthusiasm that had, perhaps, to be tempered by many a visit to the Alpine glaciers.

Leaving the first chapter of the book, which, as we have hinted, is well calculated to attract and interest, we are introduced to "The Land Region," and find ourselves confronted with a good many statistics, after which we are led on to the study of the earth's crust and its rocky constituents. Then we come to "The Air Region," in which atmospheric pressure, winds and tornadoes, and rainfall are considered; and pass on to "The Water Region," to an account of oceans and seas, of tides and currents, of snow crystals and glacier ice. This concludes the first part of the work, which is almost wholly devoted to physical geography and meteorology. We had expected to proceed into the "Fire Region," but that is dealt with in Part iii. On the whole, this first part is somewhat disappointing from a geological point of view. Lyell would doubtless have given a good account of the geological results of the *Challenger* Expedition, but these are nowhere summarised.

Part ii. is devoted to the processes of sculpture and moulding, to the polishing of rocks by nature's "sand-blast," to the raising of sand-dunes and the formation of earth-pillars. The formation of escarpments is pointed out, with especial reference to those of the Weald, as explained by Foster and Topley, and the general action of rivers is described. Landslips receive attention; and here the author has himself made a slight slip, for we are told that near Lyme Regis "the cliffs rise to a height of full a hundred feet," but where the great landslip of 1839 took place, the chalk cliffs rise to 400 or 500 feet. "Ice as Sculptor" forms the subject of one chapter, and homely illustrations are given of the bursting of water-pipes, and of the crumbling of mortar and bricks in the jerry-built structures of the nineteenth century, facts which supply the tenant and landlord with useful object-lessons. On the more serious subject of glacier-erosion, the author's conclusions have certainly the weight of personal experience. He believes the effects of a glacier are considerable, but that it acts like a plane or file rather than a chisel or gouge. Yet he admits that the tarns in mountain corries, the lakelets in mountain valleys, may be attributed to the action of ice, but not the broad sheets of Geneva or Constance. The discussion is by no means dead, for quite recently Dr. A. R. Wallace strongly maintains the truth of Ramsay's theory (*Fortnightly Review*, December). "Ice as a Carrier" and "The Work of the Ocean" are duly considered in reference to the transport of material and the carving of features. We now come to the somewhat formidable heading, "The Proletariat of Nature," which may be taken to mean the actions of the lower classes of organisms, some of which

are destructive, some protective or constructive. Peat and coal are considered, so also Foraminifera, Radiolaria, and Corals. Part iii. is headed "Changes from Within," and the old Temple of Serapis comes before us as a witness to the fluctuations of level. Movements in the earth's crust, faults, flexures and overthrusts, and the formation of mountains are considered. We pass on to volcanic action and earthquakes, and eventually to the subjects of joints, spheroidal structures, nodules, and mineral veins, all of which are briefly noticed.

In Part iv. we come to to what some may consider as geology proper; or, "The Story of Past Ages." Naturally we most of us like to go back to the very beginning, and glean what knowledge we can of the earth's probable origin; and the author briefly reviews the evidence. More interesting, however, is the chapter which deals with the eras and subdivisions in geological history, and we feel at any rate on *terra firma*. In regard to questions of correlation, the views of Prof. Huxley on "homotaxis" are given more prominence than some students of "zones" will admit to be justified by the present state of our knowledge. Nevertheless, it must be admitted that the philosophy of zones has yet to be understood, and, as the author urges, "geological contemporaneity from the general similarity of fossils must not be pressed too far." Each area must be interpreted as far as possible by its own evidence, and when the sequence of organic remains is found to be alike in areas widely apart, even the highest authorities do not claim precise, but only approximate, contemporaneity.

The Archæan era is one to which the author has paid much attention. It is a complex and comprehensive group, and barren of life, so far as our present knowledge goes. Many crystalline schists and gneisses are provisionally referred to this division, and the author is inclined to regard their general characters as a witness to their age. He points out how evidence to the contrary has in several cases broken down. Still, an attitude of reserve is desirable, when we bear in mind that great earth-movements have taken place in Tertiary times, and that deep-seated metamorphism, as Mr. Barrow has shown in the south-eastern Highlands of Scotland, is all that is wanted to produce the results.

From the chaos of the Archæan era we pass on to a chapter dealing with "The Building of the British Islands," and we are furnished with a brief account of the Cambrian, Ordovician, and Silurian periods. Restorations of the possible geography of Britain in early Carboniferous and subsequent times are given, after Jukes-Browne, and we are led on stage by stage with brief descriptions through the series of formations. With regard to the origin of boulder clay, the agency of coast-ice is maintained in opposition to that of ice-sheets; but in this, as in other cases, where serious alternative opinions are held, the different views are stated.

"The Building of Europe and other Continents" is the next subject provided for us, and we are given a brief sketch of the history of the Alps. Then follows "A Sketch of the Earth's Life History," which might better have been incorporated with the accounts of the several formations whose history was previously told, for the leading types of life are treated stratigraphically. Here, in some respects, the popular meanings given to the names of fossils are more amusing than useful. Thus we have the *Microlestes* or "little thief," the *Dromatherium* or "running beast," the *Turritella* or "cockspur," the *Plesiosaurus* or "neighbour-lizard," the *Pliosaurus* "more nearly a lizard," and so on.

The concluding part is "On Some Theoretical Questions." It deals with the age of the earth, which "is long but it is very far from being boundless." The author, in fact, as stated in his preface, thinks that we can discover "by processes strictly inductive, some sign of its beginning and some foreshadowing of its end." We are not disposed to challenge the statement.

The permanence of ocean basins and of land areas is a well-worn theme, on which "agreement ceases"; but the author is far from dogmatic on the subject. The problems of climatal change and of the distribution of life on the earth, form the topics discussed in the closing chapters.

The general reader who peruses this volume cannot but gain a sound general knowledge of geological science. In the ordinary sense of the term we cannot call it a very "popular" book, for it contains too much solid reading to please those who would read for entertainment. It must be read by those desirous of instruction; by them it will be appreciated, and for them we believe the work has been written. To the more serious student it will be of service in regard to Prof. Bonney's views; but as a work of reference it lacks importance, from the fact that the author does not, as a rule, cite original authorities, but gives references mainly to text-books and other works of a general character. That he has laboured with enthusiasm, and lightened his labours with many a pleasant, and sometimes a pungent, remark on things in general, will be evident to all who take up this volume.

CAYLEY'S PAPERS.

The Collected Mathematical Papers of Arthur Cayley, Sc.D., F.R.S., Sadlerian Professor of Pure Mathematics in the University of Cambridge. (Cambridge: University Press, 1889, *et seq.*)

LATE in the year 1887 the Syndics of the University Press requested Prof. Cayley to allow his mathematical papers to be reprinted in a collected form. To this he acceded, and also undertook the work of superintending the impression and of adding such notes and references as appeared to him desirable.

Cayley's papers, commencing in the year 1841, have appeared in every periodical mathematical publication of importance in Europe and America. A worker in pure mathematics, in whatever special department of geometry or analysis, is well-nigh certain to find that his subject has come under Cayley's hand, so comprehensive are the researches that he has presented to the scientific world. A study of one or more of these papers being thus inevitable, it is easy to appreciate the importance to a student of this wonderful collection—wonderful alike in regard to extent, to variety, and to quality. It is not our intention to attempt a sufficient review of the six volumes that have appeared in the five years that have elapsed since January, 1889. If this were the end in view, a volume would be necessary. On this occasion we purpose to glance rapidly at some of the great dis-

coveries, here set forth, which will be for ever linked to the Professor's fame.

The first volume comprises 100 papers, numbered consecutively and nearly in chronological order, produced between the dates 1841 and 1853. The paper No. 13, "On the Theory of Linear Transformations" (1845), marks a distinct epoch. Boole, in 1843, had proved the invariantive property of the discriminant of a quantic homogeneous in m variables, and Hesse, in 1844, had established certain covariantive properties of the ternary cubic. Here we find the general problem of "invariants" proposed, and some progress made towards its solution. The first step was the generalisation of Boole's theorem to a quantic of order n, containing n sets of m variables, the variables of each set entering linearly. This led to a function of the coefficients which possesses Boole's invariantive property, but it was not the discriminant as first pointed out by Ischläfli. This function, however, was seen by Cayley to necessarily satisfy a certain system of partial differential equations, and he was thence led to the capital discovery that a class of functions satisfied the same equations, and that each member of the class possessed the invariantive property. Other papers followed, and finally, in the year 1854, Cayley commenced the series of memoirs on Quantics which at intervals during the succeeding five-and-twenty years appeared in the *Philosophical Transactions* of the Royal Society. In this way the theory of algebraic invariants was gradually evolved. To this result there were many other contributors, notably Sylvester (to whom most of the nomenclature is due), Salmon, and Hammond in this country, and Aronhold, Clebsch, Gordan, and Hilbert in Germany. The first six memoirs are presented in vol. ii. of the collection. In vol. i. may be noted also the theory of conics of involution in connection with curves of the third order; the theory of "Pfaffiaus"; and the theory of surfaces of the third order. The last paper mentioned—a very important one—was developed in a correspondence with Dr. Salmon, to whom is attributed the enumeration of the twenty-seven lines on the surface. In vol. ii. we find in the notes which conclude the volume an account of the early bibliography of the theory of invariants; also the remarkable memoir on the theory of matrices, a subject which, at the present day, is exhibiting considerable vitality. The memoir appears to have been overlooked by mathematicians for more than twenty years after it appeared in 1858. The single exception appears to have been the paper by Laguerre, "Sur le Calcul des Systèmes Linéaires" (*Jour. Ec. Polyt.*, t. xxv.), in 1867. However, the subject was ultimately taken up by Sylvester, in his "Lectures on Multiple Algebra," in the *American Journal of Mathematics*, and is now an important branch of pure mathematics, both in its results and in its ideas. The volume is also remarkable for researches on the "Partitions of Numbers," "Skew Symmetric Determinants," the "Theory of Groups," "Caustics," and "Curves of the Third Order."

Vol. iii. contains notably the contributions to dynamics and astronomy. There is the valuable "Report on the recent Progress of Theoretical Dynamics," from the "Report of the British Association for the Advancement of Science, 1857." The review extends from Lagrange, 1788, to Bertrand, 1857. It, principally, gives an account of the notable contributions of Lagrange, Poisson, Sir W. R. Hamilton, and Jacobi. There are papers on Lunar Theory, Elliptic Motion, and the Problem of Three Bodies; also an extensive series of "Tables of the Development of Functions in the Theory of Elliptic Motion." The paper (No. 221) "On the Secular Acceleration of the Moon's Mean Motion" is interesting as supplying an independent verification of Prof. Adams' correction of Plana's expression for the true longitude.

Vol. iv. is chiefly remarkable for the "Report on the Progress of the Solution of certain Special Problems of Dynamics," from the Report of the British Association for the Advancement of Science for the year 1862. At the commencement the author adverts to a serious omission in his former report in volume iii. This has reference to the memoir by Ostrogradsky, "Mémoire sur les équations différentielles relatives au problème des Isopérimètres," *Mém. de St. Pét.* t. iv., 1850, which contains, in the most general form, the transformation of the equations of motion from the Lagrangian to the Hamiltonian form, and also the transformation of the system arising from any problem in the calculus of variations to the Hamiltonian form. The remark is also made that in a work by Cauchy, "Extrait du Mémoire présenté à l'Académie de Turin le 11 Oct., 1831," published in lithograph under date Turin 1832, there is satisfactory evidence that Cauchy, in the year 1831, was familiar with the Hamiltonian form of the equations of motion. Mention is made of papers on theoretical dynamics, notably by Bour, Jacobi, Natani, Clebsch, and Boole, which had appeared subsequent to the writing of the first report.

The second report includes various problems relating to the "particle" and the "solid body," "the problem of three bodies," &c. A list of memoirs is added, and increases the historical value of the report. One paper, No. 265, "Addition to the Memoir on an Extension of Arbogast's Method of Derivations," is published in this volume for the first time. The general subject of "quantics" is resumed in a seventh memoir, which is principally devoted to ternary forms. An important paper is that on the "Theory of Equations of the Fifth Order." The quintic equation cannot be solved algebraically. By the "resolution of the quintic" mathematicians understand the expression of its roots in terms of those of its resolvent sextic. During the fifteen years preceding 1861 considerable progress had been made with this problem by Cockle and Harley. In the year mentioned Cayley obtained a new auxiliary sextic equation, and showed that the roots of the quintic are, each of them, rational functions of its roots. A fresh impulse was given to the subject by George Paxton Young and Emory McClintock in vols. vi. and viii. of the *American Journal of Mathematics*, 1884-1886. The former indicated the general form of the roots of the quintic, and the latter made it possible to directly and visibly express them. In a long note at the end of the volume Prof. Cayley supplies the links between his own work and the later work of McClintock, which he considers very important and remarkable. In vol. v. there are two papers on the theory of curves in space, and in the "notes" the Professor gives his present views, taking into considera-

tion the later work of Halphen, Nöther, Valentine, and Hilbert. These authors make considerable use of Cayley's conception of the monoid surface, the curve being regarded as the partial intersection of a cone with a monoid surface; Halphen obtained the fundamental theorem which shows the existence of a monoid surface of order $n + 1$, where n is the order of the cone of lowest order which passes through all the nodal lines of the aforesaid cone. Important remarks are made on the theory arising from this notion. In the Professor's view, the question of the *classification* of curves in space, according to the representation, as the partial intersection of a cone and a monoid surface is that which properly first presents itself.

There are many papers on geometry, including those on "skew surfaces" and "sextactic points of a plane curve," with which all geometricians are familiar.

The paper No. 347, "On the Notion and Boundaries of Algebra," considers in particular the line of separation between finite and transcendental analysis. The views of so eminent a man on this subject are necessarily of interest and importance. In stating algebra to be both an art and a science, the author is in agreement with the constantly reiterated opinion of Prof. Sylvester, and indeed with that of the great majority of those who have made algebra a subject of special study. The two great divisions of algebra are stated to be "tactic" and "logistic," and the remark is made that every algebraical theorem rests, ultimately, on a tactical foundation. Mathematicians will, we think, perceive in the word "tactic" a singularly felicitous expression to denote those operations which relate to arrangement of mat rial.

The paper No. 312, "On the Partitions of a Close," generalises Euler's polyhedral relation,

$$F + S = E + 2$$

and is a first step towards Listing's well-known developments.

The frontispiece of vol vi. is a portrait of Prof. Cayley, attired in gown, seated at his desk in the act of writing. The picture is somewhat dark and not quite so pleasing as those which of recent years have appeared in NATURE and in the *American Journal of Mathematics*. The volume is principally on geometry. The memoir No. 412, on "Cubic Surfaces," adopts a classification depending on the nature of the singularities. In the notes the notation is compared with that of Zeuthen, and several apparent discrepancies in the results are explained.

There is a long memoir on the polyzomal curves

$$\sqrt[v]{U} + \sqrt[v]{V} + \ldots = 0$$

U, V, &c., being rational integral functions of the same degree in the variables. The general v-zomal curve (*i.e.* v functions U, V, &c.) is considered, and the branches, singularities, order, class, &c., determined. The investigation is intimately connected with Casey's work, on Bicircular Quartics, published in 1867 in the Proceedings of the Royal Irish Academy.

Other geometrical subjects considered are "Reciprocal Surfaces," "Skew and Developable Surfaces," "Abstract Geometry," "Cubical Divergent Parabolas," &c. In analysis we have the eighth memoir on quantics, which relates chiefly to the binary quintic; and, finally, mention may be made of the reproduction of Euler's memoir of 1758, on the rotation of a solid body.

The number of papers which appear in the six volumes is 416. Several hundreds of papers have yet to appear, and it seems improbable that a total of ten volumes will be found sufficient. This improbability is increased from the circumstance that Prof. Cayley is still producing a considerable amount of mathematical work.

For excellence of mathematical printing, and general care of production, unstinted approval may be awarded to the Cambridge University Press. These handsome volumes, as they appear, are rearing a fitting monument of the work of an eminent man, and are causing gratification and congratulation amongst mathematicians the world over.

P. A. MACMAHON.

THE PAMIRS.

The Pamirs: being a Narrative of a Year's Expedition on Horseback and on Foot through Kashmir, Western Tibet, Chinese Tartary, and Russian Cental Asia. By the Earl of Dunmore, F.R.G.S. In two volumes. (London: John Murray, 1893.)

LORD DUNMORE embodies in these volumes the journal of a somewhat remarkable journey of a year's duration, the initial and terminal points of which were Karachi and Constantinople. During most of the time he was accompanied by Major Roche, and the object of the journey was sport, especially the pursuit of the *Ovis poli*. Unfortunately this great sheep—of which Lord Dunmore (vol. ii. p. 56) appears to doubt the ovine character—inhabits a country the political geography of which is still undergoing spasmodic evolution, and there is reason to suspect the censorship of the Indian Government on all English writings bearing on the region. Thus we cannot expect any great contributions to the detailed topography of the Pamirs to be made public, and as the author makes no claim to any scientific acquirements, the botany and geology of the vast tracts wandered over are left no clearer than they were before. Major Roche, however, made an entomological collection. It is deeply to be deplored that every traveller, who is so fortunately circumstanced as to be able to push his way where few intelligent Europeans have been before, should not make some sort of preparation to fit himself for utilising his rare opportunities. For such preliminary instruction in science the Royal Geographical Society has made ample provision specially adapted to the wants of travellers, and as years go on we trust that the imputation of ignorance of what and how to observe may no longer be the necessary prelude to the criticism of works of travel in a scientific journal. Major Roche was fortunately provided with a camera, and made splendid use of it, although most of his negatives were unfortunately destroyed. Lord Dunmore himself is something of an artist, and much value must be attached to the landscapes which illustrate his book. Both travellers carried aneroids and, presumably, some surveying instruments, as a map with several new features is one of the results of the journey. We may point out that the larger-scale map of the Pamirs should have been

bound with vol. ii., in which alone that region is discussed, while the general map showing the route to Yarkand would be more useful in vol. i. One other criticism must be made before turning to the pleasanter consideration of the merits of the work. Native words are introduced in unnecessary profusion, and although *akoi*, *jigit*, *puttoo*, and seventy-five other uncouth terms are interpreted in a glossary considerately prefixed to each volume, we can only guess darkly from the context the significance of *chikore*, *chit*, and *fank*, to mention only a few we have puzzled over.

Lord Dunmore has travelled extensively in many parts of the world, and he is able to brighten his descriptions by many shrewd comparisons with distant places and diverse peoples. His power of description is above the average of the sporting traveller, and from first to last

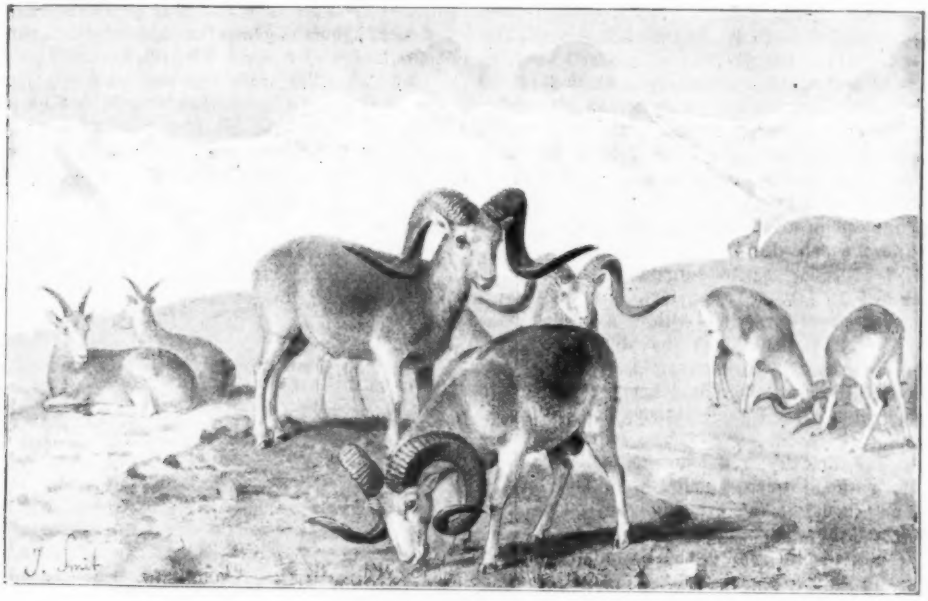

FIG. 1.—Ovis Poli.

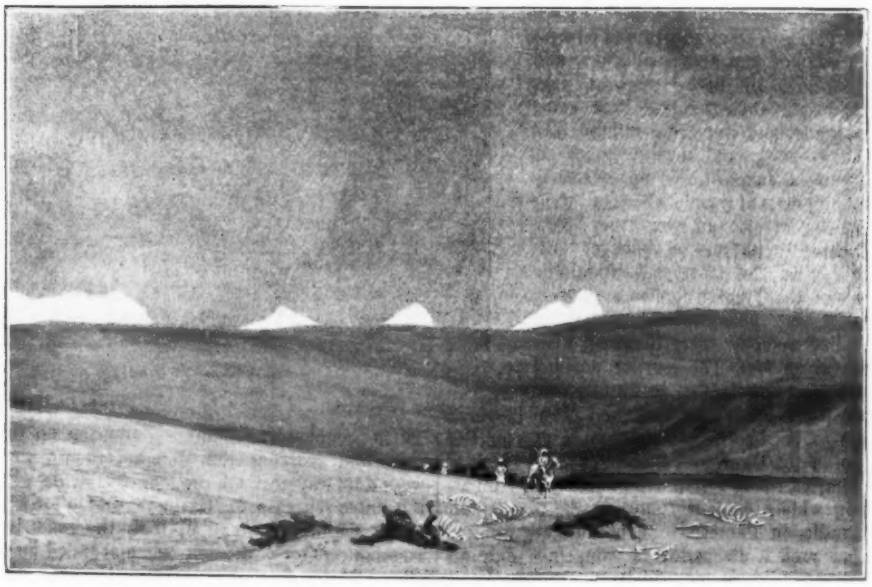

FIG. 2.—The Roof of Asia, plateau 18,000 feet above sea-level.

the two volumes may be read with pleasure and with profit. It is particularly pleasing to notice the reticence regarding his own doings, and the generous recognition given to his native attendants and the merchants and officials who showed his party kindness by the way.

Starting from Rawal Pindi on April 9, 1892, Lord Dunmore passed through Kashmir to Leh over familiar ground, climbed the Laoche Pass (18,000 feet) on yaks, crossed the Shyok valley, the scenery of which appeared on a grander scale than any in the Rocky Mountains, and completed the outfit of the expedition at Panamik, the last outpost of civilisation. On July 1, the expedition, including 30 men, 60 yaks, and 56 ponies, left Panamik, crossed the great Dapsang Plateau, an undulating plain averaging over 16,000 feet of elevation, which Lord Dunmore names "the Roof of Asia," easily surmounted the Karakoram Pass (about 19,000 feet, but all these measurements varying within a few hundred feet as determined by different aneroids), and reached Yarkand on August 4, after passing through the finest scenery of the whole journey. For eight days they camped at elevations exceeding 17,000 feet, but experienced no difficulty from mountain sickness. At Yarkand fresh supplies were laid in, and on August 18 the expedition set out again, crossed the waterless desert of Shaitan-kum, penetrated the difficult "Sariq-qol" country, and on September 6 formed a permanent camp in the Kukturak valley of the Taghdumbash Pamir, at an elevation of 15,000 feet. It was too late in the year for good sport, as the *Ovis poli* were able to find pasture close to the edge of the perpetual snow, and were often driven by herds of wild dogs right up amongst the glaciers; but some sport was obtained and the camp inhabited in spite of the growing cold until October 30. The Kirghiz were found to be an extremely hospitable and pleasant people whenever their encampments were visited, but they were curiously lacking in notions of space or time. They could not in the least understand the laboriousness of the Tibetan coolies, supposing that only as a very heavy punishment could people be called upon to carry loads on their heads, or travel on foot. The journey now led zig-zagging across the Pamirs, in bitterly cold weather, past frozen lakes and along the beds of frozen rivers to Kashgar. Lord Dunmore crossed the source region of the Oxus, and speculates as to which of several tributaries, rising within a few miles of each other, but pursuing widely devious routes, is the true "high mountain cradle in Pamere." From a geographical point of view such a discussion is vain, since only an accurate survey could decide which stream of all the streams was the longest, highest, or possessed of the greatest drainage area, and then it is a matter of hair-splitting definition to determine whether one or another of several nearly equal tributaries should retain the name of the main stream. There is, we imagine, no system akin to primogeniture which could discriminate the rights of the twin or triplet sources of the Amu-daria to exclusive physical continuity with the mature river in which they all converge. The similarity of the name Aksu, which belongs to one of them, with the name Oxus, even if, as Lord Dunmore urges, not accidental—which it certainly is—could only prove that an earlier and more ignorant generation had imagined some sort of continuity. On Lake Victoria, in the Great Pamir, a thousand miles from the sea, Lord Dunmore reports that he saw a common seagull, but he did not secure the specimen. He also discovered a new pass leading to the Alichur Pamir, to which he gave the name of Hauz Dawan, from a remarkable cistern-like lakelet which occupied its summit. Following up the Alichur river and crossing the Rangkul Pamir, the caravan wound its way through the long Gez defile which forms the narrow access to Kashgar, and after a short stay under Chinese protection, took the road to Osh, in Russian territory, where it was disbanded on January 1, 1893. Major Roche returned to Kashmir, the Russian officials not allowing him to cross the frontier, and Lord Dunmore proceeded by tarantass and sledge through Khokand and Tashkent to Samarkand, whence the trans-Caspian Railway brought him back to Europe.

FIG. 3.—The Gez defile.

The meteorological data obtained are incomplete, as the registering thermometers were only graduated to

−20° F., and could not be left outside the tents at night for fear of damage to the index by the low temperatures experienced. They are not tabulated, nor is there a detailed itinerary, but an interesting appendix shows graphically the heights of the various passes as compared with the summit of Mont Blanc.

The illustrations reproduced are selected from a profusion of admirable pictures. Fig. 1 represents the *Ovis poli* in their summer feeding-grounds close to the snow-line, and the others are typical of the most impressive plateau and gorge scenery of the region.

THE GENUS MADREPORA.

Catalogue of the Madreporarian Corals in the British Museum (*Natural History*). Vol. I. "The Genus Madrepora." By George Brook. (London, 1893.)

IT is with feelings of sad regret that we turn over the pages of this monograph. Mr. Brook laboured long and hard at the book, carried it through the press, but did not live to see his labours recognised by his colleagues. His sudden and premature death has already been noticed in NATURE (vol. xlviii. pp. 376, 420), and the present writer would like to add his testimony to the accurate and painstaking character of the work of George Brook. Happily free from pecuniary anxiety, he was able to, and did, devote his time to scientific work without regard to its paying qualities, either as to money or to immediate scientific reputation.

The monograph now under review was to be the first of a series of memoirs on the classification of the Madreporaria which were to form part of the great series of the catalogues of the British Museum. As a detailed account of the anatomy of soft parts, of histology, and of morphological problems is foreign to the general plan of this series, we must not expect to find these subjects fully dealt with in this volume; but Mr. Brook does give a succinct account of the anatomy of the genus Madrepora, so far as is at present known. For some years Mr. Brook had been studying the anatomy of the Madreporaria, and in due time he would have published his results, which would have been of great value. It is to be hoped that what has already been accomplished by him, but not yet published, will not be lost to science.

The name Madrepora appears to have been first used by Imperato in 1599; but its precise significance, or rather the sense in which the term was originally employed, does not appear to be generally understood. Imperato clearly regarded what we now speak of as the "corallum" as a stony "nurse," in the porous cups of which animal polyps undergo their development, and "stony mother" appears to indicate the meaning intended. There is no doubt that the word is, in the first instance, Italian, and Linnæus applied it to the same group of zoophytes as Imperato had done. As, however, the term was originally used to indicate the "maternal" character of the "stone" rather than its porosity, it appears that the root should be referred to the Greek πῶρος, *i.e.* stone, and the English pronunciation of the word altered accordingly. There is no need to detail here the complicated synonymy of the name; it is evident that its retention depends for its justification on custom rather than on priority. Dana and all subsequent writers, except Ehrenberg, have followed Lamarck who retained Linnæus's name for non-typical species (*M. muricata*) of the original species. Ehrenberg proposed in 1834 a new name (Heteropora) for the restricted genus as we now know it, but unfortunately his name had been preoccupied by Blainville. Prof. F. Jeffrey Bell (*A. N. H.* viii. 1891, p. 109) has also shown that the name "Holothuria" is in an analogous position. In these and similar cases, good sense, rather than a rigid adherence to rules of priority, should determine the retention of a well-known name, especially when zoologists are agreed as to the forms which are included under the term in question; but in the great majority of cases it is better to adhere to the generally accepted rules.

Dr. Duncan (*A. N. H.*, 1884, p. 181) has given an account of the structure of the corallum in three varieties of growth. As was to be expected, the quick-growing species have a lax tissue, while the slow-growing forms are very dense. Mr. Brook objects to the use of the term "costæ" for the external longitudinal ridges on the wall. The porous corallite wall is essentially composed of synapticulæ, and is therefore not a theca, as it differs both in structure and origin. According to G. von Koch's view of the origin of a theca, costæ are to be regarded as the distal extremities of septa which pass beyond the thecate wall. In the genus Madrepora the so-called costæ undoubtedly do not come under this category. They appear before the septa, and bear no regular relation to them, either in number or position.

Although the Anthozoa are generally regarded as typical radiate animals, those who have studied their embryology and anatomy recognise a fundamental bilateral symmetry which is masked by the tendency to a radial habit which characterises sessile forms. The typical number of septa is 12, viz 6 primary and 6 of a second cycle, which is usually less developed; rarely a third cycle occurs; in many species the primary cycle alone is present. The septa are generally most fully developed in the axial corallites. It is often stated as characteristic of the genus Madrepora that the axial or directive septa are more prominent than the other primary septa; but this is by no means always the case, nor is that condition confined to the genus. Whilst in axial corallites the most usual arrangement is for the primary septa to be sub-equal, in the radial corallites the directive septa are most frequently better developed—either stouter or broader—than the other primaries. In certain groups of species, however, the outer directive septum is more important than the inner; and in case only one septum is present, it is invariably the outer directive. It appears that in these cases the corresponding tentacle is longer than the remaining eleven.

For a knowledge of the soft parts, we are mainly indebted to Dr. Fowler (*Q. J. M. S.* xxvii. 1886, p. 1), although Mr. Brook did not omit to make investigations on his own account. The structure of the polyp is, in its general features, Actinian, but there is a marked bilateral

arrangement of parts. The corallum is penetrated by an intercommunicating series of canals which put the cœlentera of all the polyps into communication with each other. The mouth is elongated in the sagittal axis. The stomatodœum is supported by twelve mesenteries. The two pairs of directive mesenteries, and one mesentery on each side (Nos. 4 and 9 of Fowler's Fig. 8)—which, as in the Antipatharia, may be termed the transverse mesenteries, and are the first to be developed—are more important than the others, and extend to a lower level; they are also the longest, and are the only ones which bear reproductive organs. Similar elongate mesenteries occur in Alyonaria, in Antipatharia, and in Seriatopora and Pocillopora amongst the Madreporaria. In Antipatharia, also, they are the only ones which bear reproductive organs. The present writer has more than once (Trans. Roy. Dublin Soc. iv. 1889, p. 300; Proc. R. D. S. 1890, vii. p. 128) suggested the employment of names for the primary mesenteries which are independent either of empirical numbers or of the order of their appearance in ontogeny. According to that enumeration, here, as in the Actiniaria generally, the first mesenteries to appear are the sulculo-sulcar laterals (Lacaze Duthiers' 1, and Fowler's 4 and 9). In *Madrepora Durvillei* the other important mesenteries are the sulculo-sulcular laterals and the sulcar directives, to which must be added in *M. aspera* the sulcular directives. The inconspicuous mesenteries are the sulco-sulcar laterals and the sulco-sulcular laterals (with the addition of the sulcular directives in *M. Durvillei*). There may be details of structure peculiar to certain species of Madrepora, or even to individuals, as in dimorphic forms; but the relative values of the several mesenteries can be matched in the young and in some adults of the Actiniaria, and in the larva of Euphyllia, and among other Madreporaria.

We cannot enter into the question of classification or the characters upon which classifications have been based; suffice it to say that Mr. Brook relies primarily on the structure of the corallum. Very little is yet known upon the arrangement of the soft tissues in their relation to the corallum. It is to be expected that the varied skeletal characters are the outcome of a difference in the structure or arrangement of the soft parts; in the meantime the corallum is all there is to deal with, and the author has naturally assumed that a similarity of structure involves a close relationship, and therefore places little reliance on habit. To a certain extent the species fall into well-marked groups, if one does not regard habit of prime importance. The genus is divided into ten divisions or sub-genera; the chief place is given to the character of the axial corallite (this is analogous to the growing point of the stem or branches of a plant), and secondly to that of the radial corallites which are produced by means of indirect budding around the wall of an axial corallite. The texture of the corallum is also an important diagnostic feature, and of least value is the mode of growth or habit. We are at present quite in the dark as to the reasons why individuals of the same species should grow in a flabellate (or palmate) manner, or be luxuriantly arborescent; there is, however, a general tendency for the members of a morphological group to have a similar habit of growth.

Those who have attempted to name specimens of madrepores from the older descriptions will welcome this masterly monograph; but it is to be regretted that outline figures illustrating the details employed in classification were not appended to the synopsis of the sub-genera on p. 22. The collotype plates, although beautifully executed, illustrate more the general habit, and the critical characters therein are not readily discerned.

The genus Madrepora contains a large number of species. Mr. Brook recognises 221, of which the British Museum has 180 species out of a total of over 1100 specimens. Mr. Brook reduced 169 old species to 130 in number, but has been obliged to describe 91 new species; of these 62 appeared in the *Annals of Natural History* for 1891 and 1892. No fossil representatives are alluded to. Mr. Brook had travelled extensively in Europe in order to study the type specimens in various museums, but he had not seen the types in American museums. Eighty-six species are illustrated in the twenty-five plates, which are beautiful collotypes by Messrs. Morgan and Kidd, from the author's own negatives. Owing to the necessity for large plates the monograph is quarto in size, instead of the usual octavo of the other catalogues of the British Museum.

It is by no means an easy task to identify the species of this genus, owing to their number and varied habit. The genus Madrepora is now flourishing abundantly, and it is difficult in some cases to determine whether certain forms should be regarded as species or varieties. It is widespread, abundant, and variable forms, such as these, which are the despair of old-fashioned systematists, but serve as stimulating problems for the modern naturalist.

ALFRED C. HADDON.

PHYSIOLOGICAL CHEMISTRY.

Physiological Chemistry of the Animal Body. By Arthur Gamgee, M.D., F.R.S. Vol. II. The Physiological Chemistry of Digestion. (London: Macmillan and Co., 1893.)

THE examination of the subject of physiological chemistry may obviously be made from two separate points of view. In the first place, the different problems of the subject may be discussed from the standpoint of the organic chemist, who looks to physiology for illustration and extension of truths established by laboratory practice. In the second place, the various chemical processes occurring in the animal body may be considered from the biological standpoint, and here the domain of chemistry is invaded simply as far as necessity compels for the adequate comprehension of the biological problems presented.

The result of writing a treatise from either of these points of view alone is to largely limit the usefulness of the work, and yet it requires no inconsiderable courage to attempt to furnish a work which may be of important service both to the chemist and biologist. Dr. Gamgee has, however, been inspired with the courage of his well-recognised ability, and has presented the scientific world with a work which must at once appeal to the chemist for the thoroughness of its chemical explanation and detail, and to the biologist for the general completeness of its critical review of physiological work.

Dr. Gamgee expresses the hope that the text-book may supply a want which is at present experienced of some guide to the more advanced student and original worker. The fulness of the references given in the work alone would warrant this hope being fulfilled; and the fact that some of the most recent work is included in the volume will not lessen its anticipation. The author has not confined himself to purely physiological considerations. The pathology of jaundice, the pharmacology of icterogenic poisonous agents, the formation of gall-stones, and the nature of the gastric contents in different pathological conditions, are all treated with an amount of fulness that might not be expected in a work on physiological chemistry.

In addition to the general record and criticism of physiological work, all the important analytical methods are supplied, and it will be to some an encouragement to know that Dr. Gamgee has himself tried, as far as possible, all the experimental processes mentioned.

The present volume does not complete Dr. Gamgee's treatise on physiological chemistry. He proposes, after re-editing the first volume, to finish his work with yet another volume giving the results of a study from the chemical point of view of other animal functions. We may be permitted to express the hope that circumstances will favour the elapse of a much shorter interval than has occurred between the publication of volumes i. and ii. At the same time, the vast amount of important work that has been done during the last decade, and which has largely revolutionised our ideas of the physiological chemistry of digestion, makes the present time auspicious for the presentation of a record of such work.

The present volume is divided into thirteen chapters of varying length. The first is occupied with a consideration of *saliva*. The most recent views as to the constitution of the starch molecule, and the results of the action upon it of a diastatic ferment, are well described.

The second chapter, however, which treats of gastric digestion, will probably be regarded as the most important in the book. It commences with a short histological account of the structure of the stomach. We think that these short histological descriptions are out of place in the present work; they are not sufficiently full to be of much value to those who are likely to have occasion to use the book. The histological preliminaries are succeeded by a historical account of our knowledge concerning gastric digestion, in which the views of Van Helmont, Sylvius, Borelli, Réaumur, and Spallanzani are recorded. The nature of pepsin, the method of preparing artificial gastric juice, the nature of the acid of the stomach, are all treated upon with considerable detail. Then follows an account of the changes occurring in proteids by the action of gastric juice. After referring to the views of Meissner, Brücke, and Schutzenberger, the author goes on to record the observations and views of Kühne. The large amount of work done in recent years by Kühne, Chittenden, and Neumeister in the direction of refining our knowledge of what a few years ago was called *peptone*, is fully described. We are disposed, however, to take part with Halliburton in preferring the term *proteose* to that of *albumose*. Dr. Gamgee considers that a confusion might arise between the term *proteose* and *proto-albumose*, and prefers the general term *albumose*. But the difficulty at present experienced of causing students to understand that albumose can be derived from other proteids than albumin makes the confusion suggested by Dr. Gamgee a comparatively insignificant matter. When the terms *globulose*, *caseose*, and so on exist, it is obviously unscientific to retain the term albumose as embracing all these bodies. We are hopeful, therefore, that the change suggested by Halliburton will gradually find its way into our physiological text-books.

The milk-curdling enzyme of the stomach is referred to, and a brief account of the change that milk undergoes by its action is given. Dr. Gamgee prefers to leave a detailed consideration of these changes to a later volume dealing generally with the chemistry of milk. We think it is more desirable to treat of the change milk undergoes at the instance of a ferment in the stomach in connection with gastric digestion than at any other place. There is a rather unaccountable inconsistency in Dr. Gamgee's reference to absorption of water in the stomach. On p. 154 he states in the paragraph indicator that the stomach is "the seat of absorption of much water." In surveying the work on this subject later (p. 439 *et seq.*) he describes how recent research has established beyond a doubt the fact that the stomach does not absorb water at all (p. 441, line 20).

The third chapter treats very fully of pancreatic digestion, and appears with that on bile (chapter iv.) to be amongst the best in the volume. In connection with the latter the author has given us some very beautiful reproductions of MacMunn's spectra of bile-derivatives. The nature of the albuminoid substance of bile is referred to, and the fact that it is no longer to be regarded as *mucin*, but as a *nucleo-albumin*, is emphasised. The nature of nucleo-albumin is also briefly described. The digestive processes occurring in the small intestine are treated of in chapter ix. The different methods of experimenting are fully described. As regards the action of the enzyme of the intestinal juice, we think Dr. Gamgee has been somewhat over-influenced by tradition, which has led him to attach perhaps too much importance to its existence and action. And the fact that observers have always experienced more difficulty in obtaining positive results with extracts of the fresh mucous membrane than with so-called intestinal juice, justifies us in accepting with considerable caution inferences based upon observations on so-called permanent fistulæ.

The last chapter is devoted to a description of intracellular digestion in lower invertebrata, the digestion occurring in fishes, birds and ruminants, and supplies a becoming sequel to a comprehensive work.

Appendices are added, giving in more detail Neumeister's views concerning the albumoses, some very recent work of Kühne on the separation of albumoses and peptones; also some additional methods for the detection and estimation of the acidity of the stomach.

We should have preferred to see the index divided into two portions—one treating of subjects and the other of authors. A few mistakes occur in it, but only of trifling importance; however, it has the defect of being somewhat incomplete.

Taken altogether, we have only congratulation to offer to Dr. Gamgee on the production of this work, and have

no hesitation in stating that he is certainly justified in hoping, as he does in the preface, "that the present volume may . . . further the advancement of, and prove not altogether unworthy of, the present position of Physiology in England." J. S. EDKINS.

AN ESSAY ON NEWTON'S "PRINCIPIA."

An Essay on Newton's "Principia." By W. W. Rouse Ball. (London: Macmillan and Co., 1893.)

THE name of Newton has become now quite a household word amongst us, and one instance of its familiarity was strikingly brought home in an answer given by a small child, who when asked who was Newton, replied, "the man who found the first apple!" That two important epochs in the world's history should have been marked by the presence of this fruit, seems curious indeed; and Mr. Ball informs us that the apple anecdote in Newton's case rests on good authority, for besides written evidence, local tradition confirms it by the careful treatment the tree received, which kept it alive until the year 1820.

For the essay which we have before us, Mr. Ball should receive the thanks of all those to whom the name of Newton recalls the memory of a great man. The "Principia," besides being a lasting monument of Newton's life, is also to-day the classic of our mathematical writings, and will be so for some time to come. During Newton's lifetime three editions of this great work were brought out, the first appearing in 1687; the second, edited by Cotes, in 1713; and the third, by Pemberton, in 1726. Since the last-mentioned date, the history of the "Principia" has been discussed by Sir David Brewster and Prof. S. P. Rigaud, but both of these works are now out of print and very scarce. At the present time, as Mr. Ball informs us, it seems fitting to collect, from these and other sources, the references to the leading events in the preparation and publication of the "Principia," and the present volume contains the result of his labours. In the subject-matter, of course, there is much that is not new, but the value of the work lies in the fact that, besides containing a few as yet unpublished letters, there are collected in its pages quotations from all documents, thus forming a complete summary of everything that is known on the subject.

Mr. Ball divides his essay into six main sections, dealing with Newton's investigations in 1666, in 1679, in 1684, in 1685–1687, compilation and publication of the "Principia," the two last treating of the contents of the "Principia," and the subsequent history and preparation of later editions.

Mr. Ball commences with the works of Newton at the time when the latter had taken his degree at Cambridge, and therefore had more leisure to pursue his studies in his own way. The reader is made acquainted with Newton's early views, and there are several interesting quotations from some original manuscripts inserted. The investigations of 1879 refer, in great part, to the correspondence he had with Hooke, which turned his attention to the problem of planetary motion. It was in this year that Newton suggested the method of demonstrating the earth's motion of rotation on its axis by the letting fall of a stone from a high position, and observing the direction of the deviation from the vertical; he also repeated his calculations (with new data) for finding the relation between terrestrial gravity and the centripetal force which retained the moon in her orbit.

In 1684, Halley, after attempting to deduce the motion of the heavenly bodies from Kepler's laws, with unsuccessful results, made a visit to Cambridge, when he found that Newton "had brought this demonstration to perfection." During that year Newton gave in his professional lectures an account of his work then in manuscript form, entitled, "De Motu Corporum," which may be said to be "a rough draft of the beginning of the first book of the 'Principia.'" This period includes also Halley's second visit to Cambridge with reference to Newton's publication of this tract, and it was at this time also that Halley asked him to communicate his results to the Royal Society. The tract which Newton finally communicated was entitled, "Propositiones de Motu," and may be looked upon as marking the point at which Newton had arrived about the end of this year. Mr. Ball reproduces this tract *in extenso*, as it has only once been printed, and copies of it are scarce.

The fifth chapter deals with the investigations from 1685 to 1687, during which time Newton was preparing the "Principia." A most interesting account is given of the details concerned in the preparation of the subject-matter, while he refers also, by no means too fully, to the extreme generosity that Halley displayed, both as regards the cost of printing the books, and also to the interest he took in their progress, criticising some parts, and revising sheets for press. Rigaud, in his essay on the first publication of the "Principia," referring to this point, says, "that under the circumstances it is hardly possible to form a sufficient estimate of the immense obligation which the world owes in this respect to Halley, without whose great zeal, able management, unwearied perseverance, scientific attainments, and disinterested generosity the 'Principia' might never have been published." Mr. Ball also discusses here briefly Newton's controversy with Hooke, "the universal claimant," as he was called.

Chapter vi. is devoted to an analysis of the "Principia," a few words of introduction relating to the main differences between the first editions being given. Mr. Ball limits himself in the main to a statement of the propositions, lemmas, &c., but occasionally he breaks in with a few words of explanation, or of historical interest.

The remaining period, ending with the year 1726, contains matter dealing with the large correspondence Newton had on the contents of his "Principia," to his revision of the whole work, the extension of some of the results, and finally to the preparations of the two later editions.

The appendices contain the correspondence between Newton and Hooke and Halley, besides some memoranda on the correspondence concerning the production of the second and third editions.

From the above brief sketch of the contents of this essay, our readers may perhaps gather some idea of the ground it covers. The author is so well known a writer on anything connected with the history of mathematics, that we need make no mention of the thoroughness

of the essay, while it would be superfluous for us to add that from beginning to end it is pleasantly written, and delightful to read. Those well acquainted with the "Principia" will find much that will interest them, while those not so fully enlightened will learn much by reading through this account of the origin and history of Newton's greatest work.

WELLS ON ENGINEERING DESIGN.

Engineering Drawing and Design. By Sydney H. Wells, Wh.Sc., A.M.Inst.C.E. In Two Parts. (London: Chas. Griffin and Co., Ltd., 1893.)

THIS book is intended for the use of engineering students in schools and colleges, and as a text-book for examinations in which a knowledge of practical geometry and machine drawing is required. The author says in the preface that the chief reason which has led to its preparation is that during the time he was engaged in teaching on the engineering side of Dulwich College, he found it impossible to obtain a suitable text-book.

The work is published in two parts. Vol. i. deals with the geometrical part of the subject, but includes many references to practical questions and machinery wherein is to be found the applications of the particular geometrical construction. In the earlier treatment of this subject we find much excellent instruction for beginners, written in a clear and concise manner. The methods of construction described are all clearly illustrated, and appear to have been chosen from the best examples.

Vol. ii. deals with "machine and engine drawing and design." In the preface we find the following statement: "A student ought not to be told the sizes of bolts and nuts, or the diameter of flanges, or the details of stuffing-boxes, in drawing an engine cylinder, any more than we should expect to have to prove to him the truth of the triangle of forces, at each step in the graphical determination of the stresses in a roof truss." This statement evidently comes from the technical school view of mechanical engineering. The triangle of forces is certainly a safe assumption; but to allow one of Mr. Wells' students fresh from college to run wild in a drawing-office of an engineering works where standards are the rule, and not the exception, would be a treat not to be missed. No doubt he could turn out an excellent "technical school" drawing, but whether it would "pay" is another matter. A draughtsman generally has standards for flanges, glands, studs, &c. for an engine cylinder. Notwithstanding this, we congratulate the author on the contents of vol. ii. of his book; he has gone as far as he can to lead his students into the way of being draughtsmen; and of course this, after all, can only be accomplished—or, rather, completed—in the drawing-office of a mechanical engineer.

For the many examples and questions included in the second part we have nothing but praise; they are taken from every-day practice, and are amply elucidated. On page 183 we are told that copper pipes are made from malleable sheets, and may be as thin as $\frac{1}{16}$". Very few copper pipes of small diameters are now used by engineers made in this way; they are usually solid drawn When iron or copper pipes require flanges, these are generally brazed to the pipes; screwed flanges with locknuts are seldom, if ever, used. Unions for small brass and copper pipes are usually brazed, and not screwed on the pipes, as shown in Fig. 124*d*.

Section 26, on steam engine design, is well done. It is quite refreshing to find in a text-book of this kind that questions of manufacture and shop practice are considered worthy of notice; as a rule, such details are carefully omitted—to the student's loss. The piston-rings shown in Fig. 180*a* are far too narrow for general work; and again, in Fig. 187, illustrative of a crosshead for a single slipper guide, the slipper is far too light for its work, besides being defectively attached to the crosshead. Further on, in Fig. 191, showing a connecting-rod end, surely the author would not recommend the strap to be machined out square at the corners as shown; the much-abused "practical man" would put in a radius instead, and by so doing increase the strength considerably. The brasses are also shown apart; whereas they must be tightly brought together for the type of rod end illustrated.

Beyond these few points, the two volumes are exceedingly well written, and will be of great use to students in our technical colleges. The author has taken great pains to ensure the clearness of his descriptions, and has succeeded in producing a thoroughly useful work.

N. J. LOCKYER.

THE EGYPTIAN COLLECTIONS AT CAMBRIDGE.

Catalogue of the Egyptian Collection in the Fitzwilliam Museum. By E. A. Wallis-Budge, Litt.D. (Cambridge: University Press, 1893.)

WE recently noticed at some length Dr. Wallis-Budge's book entitled "The Mummy," and mentioned that it was intended as an introduction or a supplement to his catalogue of the antiquities which belong to the University. The catalogue itself is now before us, and is, as might be expected, a scholarly piece of work. There are people who like to read catalogues; to them this volume should prove to be of greater interest even than its companion "The Mummy"; but fortunately tastes differ, and we confess that, except perhaps to a scholar of endowments equal to those of Dr. Budge himself, "The Mummy" is the better of the two. It is satisfactory, however, to remember that the Fitzwilliam collection has been duly catalogued by competent hands, and that this catalogue is now published in an accessible form, Cambridge thus taking the lead among English universities in allowing the world to know what treasures it possesses of ancient Egyptian art. This knowledge is very valuable to the student. How many of us, for example, have seen and admired at the Louvre the granite sarcophagus of Rameses III.? Yet how few of us have known till now that the lid of the same coffin is at Cambridge? When Oxford has published a catalogue like this, and when the British Museum has followed suit, the cross references from one collection to another will in

themselves form an excellent guide and help to everyone who goes in seriously for this fascinating branch of oriental scholarship.

Dr. Budge begins with the granite coffins, and goes on to those of wood, which include two very complete and perfect examples: the sarcophagus of Nesi-pa-ur-shef, about B.C. 1500, and that of Pa-Kepu, about B.C. 500, which was brought home in 1869 by the Prince of Wales. Several pages are devoted to Canopic jars, and after them come boxes, figures of Ptah, as god of the dead, and ushabtiu figures, many of which are identified with kings, queens, princes, princesses, and other historical personages. A list of models of offerings follows. The sepulchral stelæ are then enumerated, the oldest of which only dates from the time of the eighteenth dynasty. Dr. Budge assigns the nineteenth dynasty as a date to the very interesting group of figures described on p. 85 as "sepulchral statues." The statues are succeeded by the inscribed scarabs, which are judiciously divided into those bearing the names of gods, those bearing the names of kings, those bearing the names of private persons, and those which are only marked with hieroglyphic devices. The collection is rich in scarabs, and only requires a better historical series to be very important. The earliest king named is Sahu-Ra, of the fifth dynasty, and there is a long hiatus between him and Menthuhetep V., and again between Menthuhetep V. and Usertsen of the twelfth dynasty. The members of the University who have visited Egypt must be many in number, and each of them, no doubt, has brought home his string of scarabs. Some of the blanks in the Fitzwilliam collection might well be filled up from such sources. It is beginning to be recognised tardily that a collection of regal scarabs stands to old Egypt as a collection of coins does to the history of any other country in the world.

HORNS AND HOOFS.

Horns and Hoofs; or, Chapters on Hoofed Animals. By R. Lydekker. (London: Horace Cox, *The Field* Office, 1893.)

"HORNS and Hoofs" will be a very useful volume to the sportsman and sporting naturalist, although we do not consider the title as particularly well selected to attract their notice. The work is, in fact, a more or less popular account of the principal mammals of the Ungulate order, which sportsmen ordinarily regard as "game." The chapters of which it consists originally appeared as articles in *The Field* and *Land and Water*. They have now been revised and put together in a connected form, and thus make a convenient volume of some four hundred pages.

Mr. Lydekker commences his book with an account of the *Bovidæ*, or "Hollow-horned Ruminants"—as they were formerly called by naturalists, which carry the same horny appendages on their heads throughout life—and gives us chapters on the oxen, and the sheep and goats, which constitute two of the chief subdivisions of this family. He then proceeds to the antelopes, which are far more numerous, and in reality should be classified in five or six groups of equivalent value to the Bovine and Ovine sections. Mr. Lydekker, however, finds it more convenient to treat of them in two divisions only, according to the countries which they inhabit, and devotes separate chapters to the antelopes of Asia and the antelopes of Africa. The members of the latter group are, as is well known, by far the more numerous, the total number of African antelopes already catalogued being nearly one hundred, whilst, as inner Africa is explored, new species are continually discovered, and even within the last few years several splendid novelties have been added to the series. Our author's account of these animals appears to be quite "up to date," the most recently described species, such as Hunter's Hartebeest from the River Tana, and Clarke's Gazelle from Somaliland, being introduced in their proper places. In some cases, however, he appears disposed rather to throw doubts upon what should be considered clearly established species. *Cobus maria* of Gray, which was also obtained by the German naturalist Henglin, and appropriately called *Cobus megaceros*, is, we can assure Mr. Lydekker, perfectly distinct from the Sunnu (*Cobus leucotis*), although found in nearly the same country. Moreover, the Sing-Sing (*Cobus unctuosus*) of West Africa is, we believe, as has been recently pointed out by Herr Matschie, quite distinct from the Defassa (*C. defassa*) of Abyssinia, and the name of the latter (being an Abyssinian, not a Latin term) should not be altered to "*defassus*"!

Mr. Lydekker next proceeds to the deer, or "Solid-horned Ruminants" of the older naturalists, the head-appendages of which should, however, be rather called "antlers," and are shed every year. These he also treats of geographically, devoting one chapter to the Asiatic and another to the South American series, which, as shown by the late Sir Victor Brooke, possess deep-seated anatomical characters that separate them from their old-world brethren. Owing to the slight differential characters which distinguish many of the (so-called) species of the latter group, and to the want of a good set of specimens in our museums, the South American deer, in spite of Sir Victor's efforts to get them straight, still remain in a great state of confusion. Any sporting naturalist who is short of work could not do better than devote himself to the collection of a good series of the neotropical *Cervidæ*, and try to give us a better account of them. But much as we already know of "horns and hoofs," there is still much more to be learnt even about the most familiar members of the Ungulata, and no student of the group need be in want of occupation.

Two chapters on the wild swine (*Suidæ*) and the rhinoceroses conclude Mr. Lydekker's volume, concerning which we have only to say, as in the case of the rest of his work, that all the most recent sources of information have been evidently explored for their production. Mr. Lydekker is also an excellent authority upon fossil mammals, and has availed himself of this branch of his knowledge to introduce some very useful allusions to extinct members of the various groups treated of throughout the volume. In short, we may say that "Horns and Hoofs," although specially to be recommended as a travelling companion to sportsmen and naturalists in quest of "big game," is by no means unworthy of the attention of the scientific student.